**9.5 Mechanisms of Plate Motion**

**Key Concepts**

[What are the mechanisms of plate motion?](javascript:openCrossRef('../ch9/ch9_s5_1.html%23lnk269.2'))

[What causes plate motion?](javascript:openCrossRef('../ch9/ch9_s5_1.html%23lnk269.3'))

**Vocabulary**

[convective flow](javascript:openCrossRef('../ch9/ch9_s5_1.html%23lnk269.2'))

[slab-pull](javascript:openCrossRef('../ch9/ch9_s5_1.html%23lnk269.3'))

[ridge-push](javascript:openCrossRef('../ch9/ch9_s5_1.html%23lnk269.3'))

[mantle plume](javascript:openCrossRef('../ch9/ch9_s5_1.html%23lnk269.4'))

**Causes of Plate Motion**

**Scientists generally agree that convection occurring in the mantle is the basic driving force for plate movement.** During convection, warm, less dense material rises and cooler, denser material sinks. The motion of matter resulting from convection is called [**convective flow**](javascript:openGlossaryWnd('e_ga_06_convectflw')). The slow movements of the plates and mantle are driven by the unequal distribution of Earth’s heat. The heat is generated by the radioactive decay of elements, such as uranium, found within Earth’s mantle and crust.

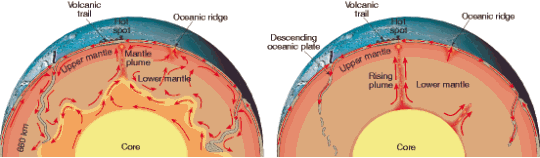
**Slab-Pull and Ridge-Push**

Several mechanisms produce forces that cause plate motion. One mechanism, called [**slab-pull**](javascript:openGlossaryWnd('e_ga_06_slabpull')), occurs because old oceanic crust, which is relatively cool and dense, sinks into the asthenosphere and “pulls” the trailing lithosphere along. **Slab-pull is thought to be the primary downward arm of convective flow in the mantle.** By contrast, [**ridge-push**](javascript:openGlossaryWnd('e_ga_06_ridgepush')) results from the elevated position of the oceanic ridge system. **Ridge-push causes oceanic lithosphere to slide down the sides of the oceanic ridge.** The downward slide is the result of gravity acting on the oceanic lithosphere. Ridge-push, although active in some spreading centers, is probably less important than slab-pull.

**Mantle Convection**

Most models suggest that hot plumes of rock are the upward flowing arms in mantle convection. These rising [**mantle plumes**](javascript:openGlossaryWnd('e_ga_06_mantleplume')) sometimes show themselves on Earth’s surface as hot spots and volcanoes.

One recent model is called whole-mantle convection. In this model, slabs of cold oceanic lithosphere descend into the lower mantle. This process provides the downward arm of convective flow, as shown in Figure 20A. At the same time, hot mantle plumes originating near the mantle-core boundary move heat toward the surface. Another model is the deep-layer model. You might compare this model to a lava lamp on a low setting. As shown in Figure 20B, the lower mantle is like the colored fluid in the bottom layer of a lava lamp. Like a lava lamp, heat from Earth’s interior causes the two layers to slowly swell and shrink in complex patterns without much mixing. A small amount of material from the lower layer flows upward as mantle plumes, creating hot-spot volcanism at the surface.



**Figure 20 Mantle Convection Models A** In the whole-mantle convection model, cold oceanic lithosphere descends into the mantle. Hot mantle plumes transport heat toward the surface. **B** The deep-layer model suggests that Earth’s heat causes these layers of convection to slowly swell and shrink in complex patterns. Some material from the lower layer flows upward as mantle plumes.

There is still much to be learned about the mechanisms that cause plates to move. But one thing is clear. **The unequal distribution of heat within Earth causes the thermal convection in the mantle that ultimately drives plate motion.** Exactly how this convection operates is still being debated.

**SECTION 9.5 Assessment**

**Reviewing Concepts**

(1)Describe the mechanisms of plate motion.

(2)What drives the slow movement of the plates and the convection in the mantle?

(3)What is the main source of heat in Earth’s interior?

**Critical Thinking**

(4) **Relating Cause And Effect** How is the theory of plate tectonics related to the radioactive decay of elements within Earth’s interior?

(5) **Calculating** If Africa and Australia are moving apart at a rate of 4.4 centimeters per year, approximately how long will it take for the ocean between the two continents to increase by 1000 kilometers?